



Dart Hawkesbury  
1270 Aberdeen St Hawkesbury, ON K6A 1K7 Canada  
Tel (613) 632-5200

## Purchasing Receipts

PO No	Supplier	Line Item No	Rel No	Terms	Purchased Item	Description	For Part No	Project	Equipment ID	Order Qty	Due Date	Received Quantity	Accounting Job No	Serial No	Status	Receive Date	Price/Unit	Aging Days	Past Due	Total	Supplier Name	
PO038311	ACI001-VC	1	1	Net 30	M5052H32S.063	5052-H32 .063 Sheet : MATERIAL: 5052-H32 ALUMINUM SHEET AS PER QQ-A-250/8 OR AMS-QQ-A-250/8 OR AMS 4016 OR ASTM B209 receive sf				64	11/14/2017	64		S009786	Stock	11/14/2017	\$ 3.70 / sf	0		\$236.97	Acier Ouellette Inc.	
		2			M4140HR0.375	4140 Round Bar .375 : AISI 4140H ROUND BAR PER AISI4140OR ASTM A304-02/-A-434-BC/-A193-03-GRADE B7/-A29-03/-A322-91 OR UNS#-G41400 MINIMUM ULTIMATE TENSILE STRENGTH=100 KSI MINIMUM YIELD TENSILE STRENGTH=66KSI receive ft				12		12		S009787	Stock	11/14/2017	\$ 10.42 / ft	0		\$125.00	Acier Ouellette Inc.	
		8			MT-4140QT-R0.875	AISI 4140 Quenched &Tempered Steel Round Bar 0.875" Dia. AISI 4140 QUENCHED & TEMPERED AS PER ASTM 4140 QT OR ASTM 4142 QT				10		10		S009788	Stock	11/14/2017	\$ 3.89 / ft	0		\$38.94	Acier Ouellette Inc.	
Total:										86			86								\$314.95	

Plex 11/14/2017 12:52 PM Dart.Plouffe.Sonia

inspection 8 17/11/20





## DELIVERY - CLIENT

CO00061363

### ACIER OUELLETTE INC.

935, Boul. du Havre  
Salaberry de Valleyfield (Québec) J6S 5L1  
Tél.: 450-377-4248 Mtl: 514-336-4248 Ext.: 800-667-4248  
Fax: 450-377-5696 Mtl: 514-336-4246 Ext.: 866-456-4242

Customer N° CLI0001056  
Date 2017/11/10  
Delivery date **2017/11/14**  
Your order N° 38311  
Processed by Josianne Bourdon  
Salesman  
Carrier OUELLETTE VALLEYFIELD  
Credit Terme Net 30 Days  
Page 1

### Billed to

DART AEROSPACE LTD  
1270, ABERDEEN ST.  
HAWKESBURY, Ontario, K6A 1K7

, Ontario,

Att : CHANTAL LAVOIE Tél.: 613-632-5200

Delivery Route 5

Instruction F-M

Product Description	Weight	Qty	U/M	PCS NB		Internal Use Only			
				CMD	EXP	B/O	IN	I	S C
<b>1</b> ALU SHEET .064 (14G) 5052-H32 (4 X 8) FEAL-064485052 <b>3174</b>  2 X 4' X 8' HEAT ac11149-ny-13/11	57.66	64.00	PI2_\$CLB		27				

### Conditions :

All sold and delivered materials remain the property of "Acier Ouellette Inc." until payment is made in full, complete and cashed. All lost materials are at the buyer's expense. The warranty offered by "Acier Ouellette Inc." is the same as offered and honored by the manufacturer and his warranty is transferred by "Acier Ouellette Inc." to the client. The buyer hereby accepts to respect the following conditions: Net 30 days from billing date and the buyer accepts to pay administration charges of 2% per month (24% per annum) on all past due amounts over 30 days. Any default in respect with this contract will lead to payment by acceleration and permits to the seller, at his choice to claim for the balance due or the repossession of the goods sold. All claims must be made within five (5) days with this document enclosed. Any merchandise that has been damaged, cut or modified cannot be returned. All goods returned must be with our authorization and are subject to a 25% restocking charge.

Total Weight (Lbs) : 57.66

NIR : R-109516-6

Prepared By :

Verified By :

Delivered By :

Time

Total (\$CAD)

Y	M	D

Customer's Signature

Date





CLI0001056

CLI0001056

2017/11/10

Delivery date	2017/11/14
---------------	------------

<b>Delivery date</b>	<b>2017/11/14</b>
<b>Your order N°</b>	<b>38311</b>

Shipped to

**Processed by**

Salesman

OUELLETTE VALLEYFIELD

Net 30 Days

Page 1

Page

**Conditions :**

All sold and delivered materials remain the property of "Acier Ouellette Inc" until payment is made in full, complete and cashed. All lost materials are at the buyer's expense. The warranty offered by Acier Ouellette Inc. is the same as offered and honored by the manufacturer and its warranty is transferred by "Acier Ouellette Inc." to the client. The buyer hereby accepts to respect the following conditions: Net 30 days from billing date and the buyer accepts to pay administration charges of 2% per month (24% per annum) on all past due amounts over 30 days. Any default in respect with this contract will lead to payment by acceleration and permits to the seller, at his choice to claim for the balance due or the repossession of the goods sold. All claims must be made within five (5) days with this document enclosed. Any merchandise that has been damaged, cut or modified cannot be returned. All goods returned must be with our authorization and are subject to 25% restocking charge.

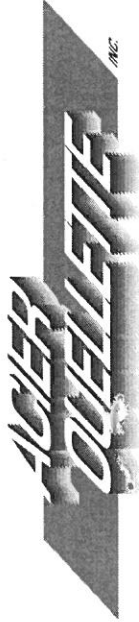
NIR : R-109516-6

Total Weight (Lbs): 4.51

Total (\$CAD)

Prepared By :	Verified By : <i>[Signature]</i>	Delivered By :	Time
<div> <div>Y</div> <div>M</div> <div>D</div> </div>			
Customer's Signature			
Date			





## DELIVERY - CLIENT

CO000061374

### ACIER OUELLETTE INC.

935, Boul. du Havre  
Salaberry de Valleyfield (Québec) J6S 5L1  
Tél.: 450-377-4248 Mtl: 514-336-4248 Ext.: 800-667-4248  
Fax: 450-377-5696 Mtl: 514-336-4246 Ext.: 866-456-4242

Customer N° CL10001056

Date 2017/11/10

Delivery date 2017/11/14

Your order N° 38311

Processed by Josianne Bourdon

Salesman

Carrier OUELLETTE VALLEYFIELD

Credit Terme Net 30 Days

Page 1

### Shipped to

DART AEROSPACE LTD

1270, ABERDEEN ST.  
HAWKESBURY, Ontario, K6A 1K7

, Ontario,

Att : CHANTAL LAVOIE Tél.: 613-632-5200

Delivery Route 5

Instruction F-M

Product Description	Weight	Qty	U/M	PCS NB			Internal Use Only			
				CMD	EXP	B/O	IN	I	S	OUT
1 ROUND 4140 HEAT TREAT 7/8 RANDOM R4140-78H-V 4997 1 X 10' HEAT COUPE A LA SCIE SCIE 1	20.45	10.00	PI_\$CLB		1X					
TRANSFERT ST-JEROME LE 13/11		1.00	UN							

NIR : R-109516-6

Total Weight (Lbs) : 20.45

**Conditions :**  
All sold and delivered materials remain the property of "Acier Ouellette Inc" until payment is made in full, complete and cashed. All lost materials are at the buyer's expense. The warranty offered by "Acier Ouellette Inc." is the same as offered and honored by the manufacturer and his warranty is transferred by "Acier Ouellette Inc." to the client. The buyer hereby accepts to respect the following conditions: Net 30 days from billing date and the buyer accepts to pay administration charges of 2% per month (24% per annum) on all past due amounts over 30 days. Any default in respect with this contract will lead to payment by acceleration and permits to the seller, at his choice to claim for the balance due or the repossession of the goods sold. All claims must be made within five (5) days with this document enclosed. Any merchandise that has been damaged, cut or modified cannot be returned. All goods returned must be with our authorization and are subject to a 25% restocking charge.

Total (\$CAD)

Prepared By :	Verified By : ybl/jam	Delivered By :	Time
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Y	M	D
---	---	---

Customer's Signature

Date





Dart Hawkesbury  
1270 Aberdeen St  
Hawkesbury, ON  
K6A 1K7  
Canada

Tel (613) 632-5200

# PURCHASE ORDER PO038311

**Supplier:** ACI001-VC  
Acier Ouellette Inc.  
935 Boul. Du Havre  
Valleyfield  
QC  
J6S 5L1 Canada  
Phone: 800 667 4248  
Fax: 450 377 5696

**PO No:** PO038311

**PO Date:** 11/9/17

**Due Date:** 11/14/17

**Purchase Order**

**Revision:**

**Revision Date:**

**Ship-To Contact:** Lavoie, Chantal  
Phone: clavoie@dartaero.com

NOV 09 2017

**Ship To:** 1270 Aberdeen Street  
Hawkesbury  
ON  
K6A 1K7 Canada  
Phone: 613-632-5200

**Via:** Ground

**Pynt Terms:** Net 30

**Freight Terms:**

**Special Comments:** QUOTATION # SOU0069540, SOU0069953,  
SOU0069784, SOU0069784, SOU0068639

## Items

Line Item	Part	Rev	Description	Item Tax	Status	Due Date	Order Quantity	Received Quantity	Balance	Unit Price (CAD)	Extended Price
1	M5052H32S.063	✓	5052-H32 .063 Sheet : MATERIAL: 5052-H32 ALUMINUM SHEET AS PER QQ-A-250/8 OR AMS-QQ-A-250/8 OR AMS 4016 OR ASTM B209 receive sf		Firmed	11/14/17	64 sf	0 sf	64 sf	\$3.7026562/sf	\$236.97
2	M4140HR0.375	✓	4140 Round Bar .375 : AISI 4140H ROUND BAR PER AISI4140OR ASTM A304-02/-A-434- BC/-A193-03-GRADE B7/-A29-03/-A322-91 OR UNS#-G41400 MINIMUM ULTIMATE TENSILE STRENGTH=100 KSI MINIMUM YIELD TENSILE STRENGTH=66KSI receive ft		Firmed	11/14/17	12 ft	0 ft	12 ft	\$10.41666/ft	\$125.00
3	M1018A3.000W.250	✓	1018 Angle 3.00" X0.250" Wall : MATERIAL: ANGLE 44W ACCEPTABLE		Firmed	11/14/17	20 ft	0 ft	20 ft	\$2.5945/ft	\$51.89
4	M1018B0.375x5.000	✓	1010-1025 Steel Bar .375 X 5.000 : MATERIAL: AISI 1010- 1025 OR ASTM A36/A366/A569/A570 OR OR CSA G40-21 38W/44W/50W/60W/70W CSA G40-21 OR 38W/44W/50W/60W/70W receive ft		Firmed	11/14/17	6 ft	0 ft	6 ft	\$11.3533/ft	\$68.12
5	M1018R0.625	✓	M1018R0.625 : MATERIAL: AISI 1018- 1025 ROUND BAR		Firmed	11/14/17	20 ft	0 ft	20 ft	\$1.0395/ft	\$20.79





Dart Hawkesbury  
1270 Aberdeen St  
Hawkesbury, ON  
K6A 1K7  
Canada

Tel (613) 632-5200

# PURCHASE ORDER PO038311

## Items

Line Item	Part	Rev	Description	Item Tax	Status	Due Date	Order Quantity	Received Quantity	Balance	Unit Price (CAD)	Extended Price
6	MT-4140QT-R0.750	✓	M1010S20GA AS PER MIL-S-7097 OR ASTM A108 receive ft AISI 4140 Quenched & Tempered Steel Round Bar 0.750" Dia. AISI 4140 QUENCHED & TEMPERED AS PER ASTM 4140 QT OR ASTM 4142 QT		Firmed	11/14/17	✓ 10 ft	0 ft	10 ft	\$1.0395/ft	\$10.40
7	MT-4140QT-R1.500	✓	AISI 4140 Quenched & Tempered Steel Round Bar 1.500" Dia. AISI 4140 QUENCHED & TEMPERED AS PER ASTM 4140 QT OR ASTM 4142 QT		Firmed	11/14/17	✓ 9.7 ft	0 ft	10 ft	\$9.8474/ft	\$95.52
8	MT-4140QT-R0.875	✓	AISI 4140 Quenched & Tempered Steel Round Bar 0.875" Dia. AISI 4140 QUENCHED & TEMPERED AS PER ASTM 4140 QT OR ASTM 4142 QT		Firmed	11/14/17	✓ 10 ft	0 ft	10 ft	\$3.894/ft	\$38.94
9	MT-4140QT-R1.750	✓	AISI 4140 Quenched & Tempered Steel Round Bar 1.750" Dia. AISI 4140 QUENCHED & TEMPERED AS PER ASTM 4140 QT OR ASTM 4142 QT		Firmed	11/14/17	✓ 5 ft	0 ft	5 ft	\$17.66/ft	\$88.30
10	MT-HRS-R-7.000	-	Hot Rolled Steel Round Bar 7.000" dia. (cut to 3.5" length) material: hot rolled steel bar as per ASTM A36 or ASTM A1011 / 44W / ASTM A1018		Firmed	11/14/17	1.167 ft	0 ft	1 ft	\$289.71594/ft	\$338.10

Line Item Note cut to size as per quote sou0069540  
4 pcs cut at 3.500"

Grand Total: \$1,074.02

## Order Notes

Procurement Quality Clauses  
A005 right of entry  
A012 chemical and physical test report  
A016 personnel qualification  
A017 raw material identification (as applicable)  
A026 certification of material conformance  
A041 quality management system  
A042 dart notification by supplier  
A043 retention of quality documents





Dart Hawkesbury  
1270 Aberdeen St  
Hawkesbury, ON  
K6A 1K7  
Canada

Tel (613) 632-5200

## **PURCHASE ORDER PO038311**

### **Order Notes**

Terms & Condition of Purchasing(Suppliers) and Procurement Quality Clauses are an integral part of our AS9100 requirements. To learn in detail, please visit [www.dartaerospace.com](http://www.dartaerospace.com) for further explanation.

A handwritten signature in black ink, appearing to be "CZ" or similar, located in the bottom right corner of the Order Notes section.

Plex 11/9/17 1:49 PM dart.lavoie.chantal



# MATERIAL RECEIPT INSPECTION FORM

MATERIAL: MT-4140QTR0.875  
 DATE: Nov.20th, 2017

PO / BATCH NO.: PO038311/S009787 *SP*

MATERIAL CERT REC'D: YES  
 QUANTITY RECEIVED: 10' 1 Bar  
 QUANTITY INSPECTED: 10' 1 Bar  
 QUANTITY REJECTED:                     

THICKNESS ORDERED: 0.875"  
 THICKNESS RECEIVED: 0.875"  
 SHEET SIZE ORDERED: N/A  
 SHEET SIZE RECEIVED: N/A

DESCRIPTION	NCR (Check Y/N)		COMMENTS
SURFACE DAMAGE	Y	N	
CORRECT FINISH	Y	N	
CORROSION	Y	N	
CORRECT GRAIN DIRECTION	Y	N	
CORRECT MATERIAL PER M-DRAWING	Y	N	YES SEE ATTACHED
CORRECT THICKNESS	Y	N	0.875"
PHOTO REQUIRED	Y	N	
CORRECT REF # TO LINK CERT	Y	N	144893
CORRECT MATERIAL IDENTIFICATION	Y	N	MT4140QTR0.875"
CORRECT M# ON THE MATERIAL	Y	N	ASTM A193/193M-01, A434,90a-BC
DOES THIS MATERIAL REQUIRE ENGINEERING SIGN OFF	Y	N	<i>SEE ATTACHED ASTM A193 5/17/17</i>
DOES THIS REQUIRE AN EXTRUSION REPORT	Y	N	

CUT SAMPLE PIECE OF MATERIAL AND PREFORM A HARDNESS CHECK. RECORD RESULTS BELOW					
	HRC	HRB	DUR A	DUR D	WEBSTER
TYPE OF MATERIAL					
SIZE OF TEST SAMPLE					
HARDNESS / DUROMETER READING					

testers located in the Quality Office

QC 18 INSPECTION		ENGINEERING SIGNOFF (if required)	
INSPECTED BY: <u>DAS</u>		SIGNED OFF BY: <u>                    </u>	
DATE: <u>9-89 17/11/20</u>		DATE: <u>                    </u>	

Attach this inspection sheet with the corresponding material cert and remit to be scanned and received in



A horizontal number line with tick marks labeled 1 through 8 from left to right.

A horizontal number line with tick marks labeled 1 through 8 from left to right.

A horizontal number line with tick marks labeled 1 through 8 from left to right.

A horizontal number line with tick marks labeled 1 through 8 from left to right.





Designation: A 193/A 193M – 04a

## Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service<sup>1</sup>

This standard is issued under the fixed designation A 193/A 193M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

Note—Corrections were made throughout editorially and the year date was changed on May 11, 2004.

### 1. Scope\*

1.1 This specification<sup>2</sup> covers alloy and stainless steel bolting material for pressure vessels, valves, flanges, and fittings for high-temperature service. The term *bolting material* as used in this specification covers bars, bolts, screws, studs, stud bolts, and wire. Bars and wire shall be hot-wrought. The material may be further processed by centerless grinding or by cold drawing. Austenitic stainless steel may be carbide solution treated or carbide solution treated and strain-hardened. When strain hardened austenitic steel is ordered, the purchaser should take special care to ensure that Appendix X1 is thoroughly understood.

1.2 Several grades are covered, including ferritic steels and austenitic stainless steels designated B5, B8, and so forth. Selection will depend upon design, service conditions, mechanical properties, and high-temperature characteristics.

NOTE 1—The committee formulating this specification has included fifteen steel types that have been rather extensively used for the present purpose. Other compositions will be considered for inclusion by the committee from time to time as the need becomes apparent.

NOTE 2—For grades of alloy-steel bolting material suitable for use at the lower range of high-temperature applications, reference should be made to Specification A 354.

NOTE 3—For grades of alloy-steel bolting material suitable for use in low-temperature applications, reference should be made to Specification A 320/A 320M.

1.3 Nuts for use with this bolting material are covered in Section 13.

1.4 Supplementary Requirements S1 through S10 are provided for use when additional tests or inspection are desired. These shall apply only when specified in the purchase order.

1.5 This specification is expressed in both inch-pound units and in SI units. However, unless the order specifies the

applicable *M* specification designation (SI units), the material shall be furnished to inch-pound units.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>3</sup>

A 194/A 194M Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

A 320/A 320M Specification for Alloy/Steel Bolting Materials for Low-Temperature Service

A 354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

A 962/A 962M Specification for Common Requirements for Steel Fasteners or Fastener Materials, or Both, Intended for Use at Any Temperature from Cryogenic to the Creep Range

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

E 21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials

E 112 Test Methods for Determining Average Grain Size

E 139 Test Methods for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials

E 150 Practice for Conducting Creep and Creep-Rupture Tension Tests of Metallic Materials Under Conditions of Rapid Heating and Short Times<sup>4</sup>

E 151 Practice for Tension Tests of Metallic Materials at

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.22 on Steel Forgings and Wrought Fittings for Piping Applications and Bolting Materials for Piping and Special Purpose Applications.

Current edition approved May 11, 2004. Published June 2004. Originally approved in 1936. Last previous edition approved in 2004 as A 193/A 193M-04.

<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-193 in Section II of that Code.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> Withdrawn.

\*A Summary of Changes section appears at the end of this standard.



Elevated Temperatures with Rapid Heating and Conventional or Rapid Strain Rates<sup>4</sup>

E 292 Test Methods for Conducting Time-for-Rupture Notch Tension Tests of Materials

E 328 Test Methods for Stress-Relaxation Tests for Materials and Structures

E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

E 566 Practice for Electromagnetic (Eddy-Current) Sorting of Ferrous Metals

E 709 Guide for Magnetic Particle Examination

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets

2.2 *ANSI Standards*:<sup>5</sup>

B1.1 Screw Threads

B18.2.1 Square and Hex Bolts and Screws

B18.2.3.1M Metric Hex Cap Screws

B18.3 Hexagon Socket and Spline Socket Screws

B18.3.1M Metric Socket Head Cap Screws

2.3 *AIAG Standard*:<sup>6</sup>

AIAG B-5 02.00 Primary Metals Identification Tag Application Standard

### 3. General Requirements and Ordering Information

3.1 Material supplied to this material specification shall conform to Specification A 962/A 962M. These requirements outline the testing and retesting methods and procedures, permissible variations in dimensions, and mass, quality and repair of defects, etc.

3.2 It is the purchaser's responsibility to specify in the purchase order all ordering information necessary to purchase the needed material. Examples of such information include, but are not limited to, the ordering information in Specification A 962/A 962M and the following:

3.2.1 Heat-treated condition (that is, normalized and tempered, or quenched and tempered, for the ferritic materials, and carbide solution treated (Class 1), carbide solution treated after finishing (Class 1A), and carbide solution treated and strain-hardened (Classes 2, 2B and 2C), for the austenitic stainless steels; Classes 1B and 1C apply to the carbide solution-treated nitrogen-bearing stainless steels; Class 1D applies to material carbide solution treated by cooling rapidly from the rolling temperature),

3.2.2 Description of items required (that is, bars, bolts, screws, or studs),

3.2.3 Nuts, if required by purchaser, in accordance with 13.1,

3.2.4 Supplementary requirements, if any, and

3.2.5 Special requirements, in accordance with 6.3, 6.5.1, 10.2, 14.1, and 15.1.

3.3 If the requirements of this specification are in conflict with the requirements of Specification A 962/A 962M the requirements of this specification shall prevail.

### 4. Manufacture (Process)

4.1 The steel shall be produced by any of the following processes: open-hearth, basic-oxygen, electric-furnace, or vacuum-induction melting (VIM). The molten steel may be vacuum-treated prior to or during pouring of the ingot or strand casting.

4.2 *Quality*—See Specification A 962/A 962M for requirements.

### 5. Discard

5.1 A sufficient discard shall be made to secure freedom from injurious piping and undue segregation.

### 6. Heat Treatment

6.1 Ferritic steels shall be properly heat treated as best suits the high-temperature characteristics of each grade. Immediately after rolling or forging, the bolting material shall be allowed to cool to a temperature below the cooling transformation range. The materials which are to be furnished in the liquid-quenched condition shall then be uniformly reheated to the proper temperature to refine the grain (a group thus reheated being known as a *quenching charge*) and quenched in a liquid medium under substantially uniform conditions for each quenching charge. Use of water quenching is prohibited for any ferritic grade when heat treatment is part of the fastener manufacturing process. This prohibition does not apply to heat treated bar or to fasteners machined therefrom. Material Grade B16 shall be heated to a temperature range from 1700 to 1750°F [925 to 954°C] and oil quenched. The materials that are to be furnished in the normalized or air-quenched condition shall be reheated to the proper temperature to refine the grain and cooled uniformly in air to a temperature below the transformation temperature range. The material, whether liquid-quenched or normalized, shall then be uniformly reheated for tempering. The minimum tempering temperature shall be as specified in Table 2 and Table 3.

<sup>5</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

<sup>6</sup> Available from Automotive Industry Action Group, 26200 Lahser, Suite 200, Southfield, MI 48034.





## A 193/A 193M – 04a

TABLE 1 Chemical Requirements (Composition, percent)<sup>A</sup>

Type . . . . .	Ferritic Steels			
Grade . . . . .	B5		B6 and B6X	
UNS Designation . . . . .	5% Chromium		12 % Chromium	
	S 41000 (410)			
	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation Over or Under <sup>B</sup>
Carbon	0.10 min	0.01 under	0.08–0.15	0.01 over
Manganese, max	1.00	0.03 over	1.00	0.03 over
Phosphorus, max	0.040	0.005 over	0.040	0.005 over
Sulfur, max	0.030	0.005 over	0.030	0.005 over
Silicon	1.00 max	0.05 over	1.00 max	0.05 over
Chromium	4.0–6.0	0.10	11.5–13.5	0.15
Molybdenum	0.40–0.65	0.05	...	...

Type . . . . .	Ferritic Steels			
Grade . . . . .	B7, B7M		B16	
Description . . . . .	Chromium-Molybdenum <sup>C</sup>		Chromium-Molybdenum-Vanadium	
	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation, Over or Under <sup>B</sup>
Carbon	0.37–0.49 <sup>D</sup>	0.02	0.36–0.47	0.02
Manganese	0.65–1.10	0.04	0.45–0.70	0.03
Phosphorus, max	0.035	0.005 over	0.035	0.005 over
Sulfur, max	0.040	0.005 over	0.040	0.005 over
Silicon	0.15–0.35	0.02	0.15–0.35	0.02
Chromium	0.75–1.20	0.05	0.80–1.15	0.05
Molybdenum	0.15–0.25	0.02	0.50–0.65	0.03
Vanadium	...	...	0.25–0.35	0.03
Aluminum, max % <sup>E</sup>	...	...	0.015	...

Type . . . . .	Austenitic Steels, <sup>F</sup> Classes 1, 1A, 1D, and 2							
Grade . . . . .	B8, B8A		B8C, B8CA		B8M, B8MA, B8M2, B8M3		B8P, B8PA	
UNS Designation . . . . .	S 30400 (304)		S 34700 (347)		S 31600 (316)		S 30500	
	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation, Over or Under <sup>B</sup>
Carbon, max	0.08	0.01 over	0.08	0.01 over	0.08	0.01 over	0.12	0.01 over
Manganese, max	2.00	0.04 over	2.00	0.04 over	2.00	0.04 over	2.00	0.04 over
Phosphorus, max	0.045	0.010 over	0.045	0.010 over	0.045	0.010 over	0.045	0.010 over
Sulfur, max	0.030	0.005 over	0.030	0.005 over	0.030	0.005 over	0.030	0.005 over
Silicon, max	1.00	0.05 over	1.00	0.05 over	1.00	0.05 over	1.00	0.05 over
Chromium	18.0–20.0	0.20	17.0–19.0	0.20	16.0–18.0	0.20	17.0–19.0	0.20
Nickel	8.0–11.0	0.15	9.0–12.0	0.15	10.0–14.0	0.15	11.0–13.0	0.15
Molybdenum	...	...	...	...	2.00–3.00	0.10	...	...
Columbium + tantalum	...	...	10 x carbon content, min; 1.10 max	0.05 under	...	...	...	...





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TABLE 1 Continued

Type	Austenitic Steels <sup>F</sup> , Classes 1A, 1B, 1D, and 2				
Grade	B8N, B8NA		B8MN, B8MNA		B8MLCuN, B8MLCuNA
UNS Designation	S 30451 (304N)		S 31651 (316N)		S 31254
	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation, Over or Under <sup>B</sup>	Range
Carbon, max	0.08	0.01 over	0.08	0.01 over	0.020
Manganese, max	2.00	0.04 over	2.00	0.04 over	1.00
Phosphorus, max	0.045	0.010 over	0.045	0.010 over	0.030
Sulfur, max	0.030	0.005 over	0.030	0.005 over	0.010
Silicon, max	1.00	0.05 over	1.00	0.05 over	0.80
Chromium	18.0–20.0	0.20	16.0–18.0	0.20	19.5–20.5
Nickel	8.0–11.0	0.15	10.0–13.0	0.15	17.5–18.5
Molybdenum	...	...	2.00–3.00	0.10	6.0–6.5
Nitrogen	0.10–0.16	0.01	0.10–0.16	0.01	0.18–0.22
Copper	...	...	...	...	0.50–1.00

Type	Austenitic Steels <sup>F</sup> , Classes 1, 1A, and 2		
Grade	B8T, B8TA		
UNS Designation	S 32100 (321)		
	Range	Product Variation, Over or Under <sup>B</sup>	
Carbon, max	0.08	0.01 over	
Manganese, max	2.00	0.04 over	
Phosphorus, max	0.045	0.010 over	
Sulfur, max	0.030	0.005 over	
Silicon, max	1.00	0.05 over	
Nickel	9.0–12.0	0.15	
Chromium	17.0–19.0	0.20	
Titanium	5 x (C + N) min, 0.70 max	0.05 under	

Type	Austenitic Steels <sup>F</sup> , Classes 1C and 1D			
Grade	B8R, B8RA		B8S, B8SA	
UNS Designation	S 20910		S 21800	
	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation, Over or Under <sup>B</sup>
Carbon, max	0.06	0.01 over	0.10	0.01 over
Manganese	4.0–6.0	0.05	7.0–9.0	0.06
Phosphorus, max	0.045	0.005 over	0.060	0.005 over
Sulfur, max	0.030	0.005 over	0.030	0.005 over
Silicon	1.00 max	0.05 over	3.5–4.5	0.15
Chromium	20.5–23.5	0.25	16.0–18.0	0.20
Nickel	11.5–13.5	0.15	8.0–9.0	0.10
Molybdenum	1.50–3.00	0.10	...	...
Nitrogen	0.20–0.40	0.02	0.08–0.18	0.01
Columbium + tantalum	0.10–0.30	0.05	...	...
Vanadium	0.10–0.30	0.02	...	...

Type	Austenitic Steels <sup>F</sup> , Classes 1, 1A and 1D			
Grade	B8LN, B8LNA		B8MLN, B8MLNA	
UNS Designation	S 30453		S 31653	
	Range	Product Variation, Over or Under <sup>B</sup>	Range	Product Variation, Over or Under <sup>B</sup>
Carbon, max	0.030	0.005 over	0.030	0.005 over
Manganese	2.00	0.04 over	2.00	0.04 over
Phosphorus, max	0.045	0.010 over	0.045	0.010 over
Sulfur, max	0.030	0.005 over	0.030	0.005 over
Silicon	1.00	0.05 over	1.00	0.05 over
Chromium	18.0–20.0	0.20	16.0–18.0	0.20
Nickel	8.0–11.0	0.15	10.0–13.0	0.15
Molybdenum	...	...	2.00–3.00	0.10
Nitrogen	0.10–0.16	0.01	0.10–0.16	0.01

<sup>A</sup> The intentional addition of Bi, Se, Te, and Pb is not permitted.

<sup>B</sup> Product analysis—Individual determinations sometimes vary from the specified limits on ranges as shown in the tables. The several determinations of any individual element in a heat may not vary both above and below the specified range.

<sup>C</sup> Typical steel compositions used for this grade include 4140, 4142, 4145, 4140H, 4142H, and 4145H.

<sup>D</sup> For bar sizes over 3½ in. [90 mm], inclusive, the carbon content may be 0.50 %, max. For the B7M grade, a minimum carbon content of 0.28 % is permitted, provided that the required tensile properties are met in the section sizes involved; the use of AISI 4130 or 4130H is allowed.

<sup>E</sup> Total of soluble and insoluble.





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<sup>F</sup> Classes 1 and 1D are solution treated. Classes 1, 1B, and some 1C (B8R and B8S) products are made from solution treated material. Class 1A (B8A, B8CA, B8MA, B8PA, B8TA, B8LNA, B8MLNA, B8NA, and B8MNA) and some Class 1C (B9RA and B8SA) products are solution treated in the finished condition. Class 2 products are solution treated and strain hardened.

**TABLE 2 Mechanical Requirements — Inch Products**

Grade	Diameter, in.	Minimum Tempering Temperature, °F	Tensile Strength, min, ksi	Yield Strength, min, 0.2 % offset, ksi	Elongation in 4D, min, %	Reduction of Area, min, %	Hardness, max
Ferritic Steels							
B5 4 to 6 % chromium	up to 4, incl	1100	100	80	16	50	...
B6 13 % chromium	up to 4, incl	1100	110	85	15	50	...
B6X 13 % chromium	up to 4, incl	1100	90	70	16	50	26 HRC
B7 Chromium-molybdenum	2½ and under	1100	125	105	16	50	321 HB or 35 HRC
	over 2½ to 4	1100	115	95	16	50	321 HB or 35 HRC
	over 4 to 7	1100	100	75	18	50	321 HB or 35 HRC
B7M <sup>A</sup> Chromium-molybdenum	4 and under	1150	100	80	18	50	235 HB or 99 HRB
	over 4 to 7	1150	100	75	18	50	235 BHN or 99 HRB
B16 Chromium-molybdenum-vanadium	2½ and under	1200	125	105	18	50	321 HB or 35 HRC
	over 2½ to 4	1200	110	95	17	45	321 HB or 35 HRC
	over 4 to 8	1200	100	85	16	45	321 HB or 35 HRC

Grade, Diameter, in.	Heat Treatment <sup>B</sup>	Tensile Strength, min, ksi	Yield Strength, min, 0.2 % offset, ksi	Elongation in 4 D, min %	Reduction of Area, min %	Hardness, max
Austenitic Steels						
Classes 1 and 1D; B8, B8M, B8P, carbide solution treated B8LN, B8MLN, all diameters		75	30	30	50	223 HB <sup>C</sup> or 96 HRB
Class 1: B8C, B8T, all diameters	carbide solution treated	75	30	30	50	223 HB <sup>C</sup> or 96 HRB
Class 1A: B8A, B8CA, B8MA, B8PA, B8TA, B8LNA, B8MLNA, B8NA, B8MNA B8MLCuNA, all diameters	carbide solution treated in the finished condition	75	30	30	50	192 HB or 90 HRB
Classes 1B and 1D: B8N, B8MN, and B8MLCuN, all diameters	carbide solution treated	80	35	30	40	223 HB <sup>C</sup> or 96 HRB
Classes 1C and 1D: B8R, all diameters	carbide solution treated	100	55	35	55	271 HB or 28 HRC
Class 1C: B8RA, all diameters	carbide solution treated in the finished condition	100	55	35	55	271 HB or 28 HRC
Classes 1C and 1D: B8S, all diameters	carbide solution treated	95	50	35	55	271 HB or 28 HRC
Classes 1C: B8SA, all diameters	carbide solution treated in the finished condition	95	50	35	55	271 HB or 28 HRC
Class 2: B8, B8C, B8P, B8T, and B8N, <sup>D</sup> ¾ and under	carbide solution treated and strain hardened	125	100	12	35	321 HB or 35 HRC
over ¾ to 1, incl		115	80	15	35	321 HB or 35 HRC
over 1 to 1¼, incl		105	65	20	35	321 HB or 35 HRC
over 1¼ to 1½, incl		100	50	28	45	321 HB or 35 HRC
Class 2: B8M, B8MN, B8MLCuN <sup>D</sup> ¾ and under	carbide solution treated and strain hardened	110	95	15	45	321 HB or 35 HRC
over ¾ to 1 incl		100	80	20	45	321 HB or 35 HRC





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TABLE 2 Continued

Grade, Diameter, in.	Heat Treatment <sup>B</sup>	Tensile Strength, min, ksi	Yield Strength, min, 0.2 % offset, ksi	Elongation in 4 D, min %	Reduction of Area, min %	Hardness, max
Austenitic Steels						
Over 1 to 1¼, incl		95	65	25	45	321 HB or 35 HRC
over 1¼ to 1½, incl		90	50	30	45	321 HB or 35 HRC
Class 2B: B8, B8M2 <sup>D</sup>	carbide solution treated and strain hardened	95	75	25	40	321 HB or 35 HRC
2 and under						
over 2 to 2½ incl		90	65	30	40	321 HB or 35 HRC
over 2½ to 3 incl		80	55	30	40	321 HB or 35 HRC
Class 2C: B8M3 <sup>D</sup>	carbide solution treated and strain hardened	85	65	30	60	321 HB or 35 HRC
2 and under						
over 2		85	60	30	60	321 HB or 35 HRC

<sup>A</sup> To meet the tensile requirements, the Brinell hardness shall be over 200 HB (93 HRB).

<sup>B</sup> Class 1 is solution treated. Class 1A is solution treated in the finished condition for corrosion resistance; heat treatment is critical due to physical property requirement. Class 2 is solution treated and strain hardened. Austenitic steels in the strain-hardened condition may not show uniform properties throughout the section particularly in sizes over ¾ in. in diameter.

<sup>C</sup> For sizes ¾ in. in diameter and smaller, a maximum hardness of 241 HB (100 HRB) is permitted.

<sup>D</sup> For diameters 1½ and over, center (core) properties may be lower than indicated by test reports which are based on values determined at ½ radius.

TABLE 3 Mechanical Requirements —Metric Products

Class	Diameter, [mm]	Minimum Tempering Temperature, °C	Tensile Strength, min, MPa	Yield Strength, min, 0.2 % offset, MPa	Elongation in 4D, min, %	Reduction of Area, min, %	Hardness, max
Ferritic Steels							
B5							
4 to 6 % chromium	up to M100, incl	593	690	550	16	50	...
B6							
13 % chromium	up to M100, incl	593	760	585	15	50	...
B6X							
13 % chromium	up to M100, incl	593	620	485	16	50	26 HRC
B7							
Chromium-molybdenum	M64 and under	593	860	720	16	50	321 HB or 35 HRC
	over M64 to M100	593	795	655	16	50	321 HB or 35 HRC
	over M100 to M180	593	690	515	18	50	321 HB or 35 HRC
B7M <sup>A</sup> Chromium-molybdenum	M100 and under	620	690	550	18	50	235 HB or 99 HRB
	over M100 to M180	620	690	515	18	50	235 BHN or 99 HRB
B16							
Chromium-molybdenum-vanadium	M64 and under	650	860	725	18	50	321 HB or 35 HRC
	over M64 to M100	650	760	655	17	45	321 HB or 35 HRC
	over M100 to M180	650	690	586	16	45	321 HB or 35 HRC
Class Diameter, mm	Heat Treatment <sup>B</sup>		Tensile Strength, min, MPa	Yield Strength, min, 0.2 % offset, MPa	Elongation in 4 D, min %	Reduction of Area, min %	Hardness, max
Austenitic Steels							
Classes 1 and 1D: B8, B8M, B8P, B8LN, carbide solution treated			515	205	30	50	223 HB <sup>C</sup> or 96 HRB
B8MLN, all diameters							
Class 1: B8C, B8T, all diameters	carbide solution treated		515	205	30	50	223 HB <sup>C</sup> or 96HRB
Class 1A: B8A, B8CA, B8MA, B8PA, B8TA, B8LNA, B8MLNA, B8NA, B8MNA	carbide solution treated in the finished condition		515	205	30	50	192 HB or 90 HRB
B8MLCuNA, all diameters							
Classes 1B and 1D: B8N, B8MN, and B8MLCuN, all diameters	carbide solution treated		550	240	30	40	223 HB <sup>C</sup> or 96 HRB
Classes 1C and 1D: B8R, all diameters	carbide solution treated		690	380	35	55	271 HB or 28 HRC





TABLE 3 Continued

Class Diameter, mm	Heat Treatment <sup>B</sup>	Tensile Strength, min, MPa	Yield Strength, min, 0.2 % offset, MPa	Elongation in 4 D, min %	Reduction of Area, min %	Hardness, max
Austenitic Steels						
Class 1C: B8RA, all diameters	carbide solution treated in the finished condition	690	380	35	55	271 HB or 28 HRC
Classes 1C and 1D: B8S, all diameters	carbide solution treated	655	345	35	55	271 HB or 28 HRC
Classes 1C: B8SA, all diameters	carbide solution treated in the finished condition	655	345	35	55	271 HB or 28 HRC
Class 2: B8, B8C, B8P, B8T, and B8N, <sup>D</sup> M20 and under	carbide solution treated and strain hardened	860	690	12	35	321 HB or 35 HRC
over M20 to M24, incl		795	550	15	35	321 HB or 35 HRC
over M24 to M30, incl		725	450	20	35	321 HB or 35 HRC
over M30 to M36, incl		690	345	28	45	321 HB or 35 HRC
Class 2: B8M, B8MN, B8MLCuN, <sup>D</sup> M20 and under	carbide solution treated and strain hardened	760	655	15	45	321 HB or 35 HRC
over M20 to M24, incl		690	550	20	45	321 HB or 35 HRC
over M24 to M30, incl		655	450	25	45	321 HB or 35 HRC
over M30 to M36, incl		620	345	30	45	321 HB or 35 HRC
Class 2B: B8, B8M2, <sup>D</sup> M48 and under	carbide solution treated and strain hardened	655	515	25	40	321 HB or 35 HRC
over M48 to M64, incl		620	450	30	40	321 HB or 35 HRC
over M64 to M72, incl		550	380	30	40	321 HB or 35 HRC
Class 2C: B8M3, <sup>D</sup> M48 and under	carbide solution treated and strain hardened	585	450	30	60	321 HB or 35 HRC
over M48		585	415	30	60	321 HB or 35 HRC

<sup>A</sup> To meet the tensile requirements, the Brinell hardness shall be over 200 HB (93 HRB).

<sup>B</sup> Class 1 is solution treated. Class 1A is solution treated in the finished condition for corrosion resistance; heat treatment is critical due to physical property requirement. Class 2 is solution treated and strain hardened. Austenitic steels in the strain-hardened condition may not show uniform properties throughout the section particularly in sizes over M20 mm in diameter.

<sup>C</sup> For sizes M20 mm in diameter and smaller, a maximum hardness of 241 HB (100 HRB) is permitted.

<sup>D</sup> For diameters M38 and over, center (core) properties may be lower than indicated by test reports which are based on values determined at 1/2 radius.

6.1.1 Quenched and tempered or normalized and tempered ferritic material that is subsequently cold drawn for dimensional control shall be stress-relieved after cold drawing. The minimum stress-relief temperature shall be 100°F [55°C] below the tempering temperature. Tests for mechanical properties shall be performed after stress relieving.

6.2 Both B6 and B6X materials shall be held, at the tempering temperature for a minimum time of 1 h. Identification Symbol B 6X material may be furnished in the as-rolled-and-tempered condition. Cold working is permitted with the hardness limitation (26 HRC maximum) of Table 2 for the B 6X grade.

6.3 All austenitic stainless steels shall receive a carbide solution treatment (see 6.3.1-6.3.4 for specific requirements for each class). Classes 1, 1B, 1C (Grades B8R and B8S only), 2, 2B, and 2C can apply to bar, wire, and finished fasteners. Class 1A (all grades) and Class 1C (grades B8RA and B8SA only) can apply to finished fasteners. Class 1D applies only to bar and wire and finished fasteners that are machined directly from Class 1D bar or wire without any subsequent hot or cold working.

6.3.1 *Classes 1 and 1B, and Class 1C Grades B8R and B8S*—After rolling of the bar, forging, or heading, whether done hot or cold, the material shall be heated from ambient temperature and held a sufficient time at a temperature at which the chromium carbide will go into solution and then shall be cooled at a rate sufficient to prevent the precipitation of the carbide.

6.3.2 *Class 1D*—Rolled or forged Grades B8, B8M, B8P, B8LN, B8MLN, B8N, B8MN, B8R, and B8S bar shall be cooled rapidly immediately following hot working while the temperature is above 1750°F [955°C] so that grain boundary carbides are in solution. Class 1D shall be restricted to applications at temperatures less than 850°F [455°C].

6.3.3 *Class 1A and Class 1C Grades B8RA and B8SA*—Finished fasteners shall be carbide solution treated after all rolling, forging, heading, and threading operations are complete. This designation does not apply to starting material such as bar. Fasteners shall be heated from ambient temperature and held a sufficient time at a temperature at which the chromium carbide will go into solution and then shall be cooled at a rate sufficient to prevent the precipitation of the carbide.

6.3.4 *Classes 2, 2B, and 2C*—Material shall be carbide solution treated by heating from ambient temperature and holding a sufficient time at a temperature at which the chromium carbide will go into solution and then cooling at a rate sufficient to prevent the precipitation of the carbide. Following this treatment the material shall then be strain hardened to achieve the required properties.

NOTE 4—Heat treatment following operations performed on a limited portion of the product, such as heading, may result in non-uniform grain size and mechanical properties through the section affected.

6.4 If scale-free bright finish is required, this shall be specified in the purchase order.

6.5 B7 and B7M bolting material shall be heat treated by quenching in a liquid medium and tempering. For B7M



bolting, the final heat treatment, which may be the tempering operation if conducted at 1150°F [620°C] minimum, shall be done after all machining and forming operations, including thread rolling and any type of cutting. Surface preparation for hardness testing, nondestructive evaluation, or ultrasonic bolt tensioning is permitted.

6.5.1 Unless otherwise specified, material for Grade B7 may be heat treated by the Furnace, the Induction or the Electrical Resistance method.

NOTE 5—It should be taken into consideration that stress-relaxation properties may vary from heat lot to heat lot or these properties may vary from one heat treating method to another. The purchaser may specify Supplementary Requirement S8, if stress-relaxation testing is desired.

## 7. Chemical Composition

7.1 Each alloy shall conform to the chemical composition requirements prescribed in Table 1.

7.2 The steel shall not contain an unspecified element for the ordered grade to the extent that the steel conforms to the requirements of another grade for which that element is a specified element. Furthermore, elements present in concentrations greater than 0.75 weight/% shall be reported.

## 8. Heat Analysis

8.1 An analysis of each heat of steel shall be made by the manufacturer to determine the percentages of the elements specified in Section 7. The chemical composition thus determined shall be reported to the purchaser or the purchaser's representative, and shall conform to the requirements specified in Section 7. Should the purchaser deem it necessary to have the transition zone of two heats sequentially cast discarded, the purchaser shall invoke Supplementary Requirement S3 of Specification A 788.

## 9. Mechanical Properties

### 9.1 Tensile Properties:

9.1.1 *Requirements*—The material as represented by the tension specimens shall conform to the requirements prescribed in Table 2 at room temperature after heat treatment. Alternatively, stainless strain hardened headed fasteners (Class 2, 2B, and 2C) shall be tested full size after strain hardening to determine tensile strength and yield strength and shall conform to the requirements prescribed in Table 2. Should the results of full size tests conflict with results of tension specimen tests, full size test results shall prevail.

9.1.2 *Full Size Fasteners, Wedge Tensile Testing*—When applicable, see 12.1.3, headed fasteners shall be wedge tested full size and shall conform to the tensile strength shown in Table 2. The minimum full size breaking strength (lbf) for individual sizes shall be as follows:

$$T_s = UTS \times A_s \quad (1)$$

where:

$T_s$  = wedge tensile strength,  
 $UTS$  = tensile strength specified in Table 2, and  
 $A_s$  = stress area, square inches, as shown in ANSI B1.1 or calculated as follows:

$$A_s = 0.785 (D - (0.974/n))^2 \quad (2)$$

where:

$D$  = nominal thread size, and  
 $n$  = the number of threads per inch.

### 9.2 Hardness Requirements:

9.2.1 The hardness shall conform to the requirements prescribed in Table 2. Hardness testing shall be performed in accordance with either Specification A 962/A 962M or with Test Methods F 606.

9.2.2 *Grade B7M*—The maximum hardness of the grade shall be 235 HB or 99 HRB. The minimum hardness shall not be less than 200 HB or 93 HRB. Conformance to this hardness shall be ensured by testing the hardness of each stud or bolt by Brinell or Rockwell B methods in accordance with 9.2.1. The use of 100 % electromagnetic testing for hardness as an alternative to 100 % indentation hardness testing is permissible when qualified by sampling using indentation hardness testing. Each lot tested for hardness electromagnetically shall be 100 % examined in accordance with Practice E 566. Following electromagnetic testing for hardness a random sample of a minimum of 100 pieces of each heat of steel in each lot (as defined in 12.1.1) shall be tested by indentation hardness methods. All samples must meet hardness requirements to permit acceptance of the lot. If any one sample is outside of the specified maximum or minimum hardness, the lot shall be rejected and either reprocessed and resampled or tested 100 % by indentation hardness methods. Product that has been 100 % tested and found acceptable shall have a line under the grade symbol.

9.2.2.1 Surface preparation for indentation hardness testing shall be in accordance with Test Methods E 18. Hardness tests shall be performed on the end of the bolt or stud. When this is impractical, the hardness test shall be performed elsewhere.

## 10. Workmanship, Finish, and Appearance

10.1 Bolts, screws, studs, and stud bolts shall be pointed and shall have a workmanlike finish. Points shall be flat and chamfered or rounded at option of the manufacturer. Length of point on studs and stud bolts shall be not less than one nor more than two complete threads as measured from the extreme end parallel to the axis. Length of studs and stud bolts shall be measured from first thread to first thread.

10.2 Bolt heads shall be in accordance with the dimensions of ANSI B18.2.1 or ANSI B18.2.3.1M. Unless otherwise specified in the purchase order, the Heavy Hex Screws Series should be used, except the maximum body diameter and radius of fillet may be the same as for the Heavy Hex Bolt Series. The body diameter and head fillet radius for sizes of Heavy Hex Cap Screws and Bolts that are not shown in their respective tables in ANSI B18.2.1 or ANSI B18.2.3.1M may be that shown in the corresponding Hex Cap Screw and Bolt Tables respectively. Socket head fasteners shall be in accordance with ANSI B18.3 or ANSI B18.3.1M.

## 11. Retests

11.1 If the results of the mechanical tests of any test lot do not conform to the requirements specified, the manufacturer may retreat such lot not more than twice, in which case two additional tension tests shall be made from such lot, all of which shall conform to the requirements specified.



## 12. Test Specimens

12.1 *Number of Tests*—For heat-treated bars, one tension test shall be made for each diameter of each heat represented in each tempering charge. When heat treated without interruption in continuous furnaces, the material in a lot shall be the same heat, same prior condition, same size, and subjected to the same heat treatment. Not fewer than two tension tests are required for each lot containing 20 000 lb [9000 kg] or less. Every additional 10 000 lb [4500 kg] or fraction thereof requires one additional test.

12.1.1 For studs, bolts, screws, and so forth, one tension test shall be made for each diameter of each heat involved in the lot. Each lot shall consist of the following:

Diameter, in. [mm]	Lot Size
1½ [30] and under	1500 lb [780 kg] or fraction thereof
Over 1½ [30] to 1¾ [42], incl	4500 lb [2000 kg] or fraction thereof
Over 1¾ [42] to 2½ [64], incl	6000 lb [2700 kg] or fraction thereof
Over 2½ [64]	100 pieces or fraction thereof

12.1.2 Tension tests are not required to be made on bolts, screws, studs, or stud bolts that are fabricated from heat-treated bars furnished in accordance with the requirements of this specification and tested in accordance with 12.1, provided they are not given a subsequent heat treatment.

12.1.3 *Full Size Specimens, Headed Fasteners*—Headed fasteners 1½ in. in body diameter and smaller, with body length three times the diameter or longer, and that are produced by upsetting or forging (hot or cold) shall be subjected to full size testing in accordance with 9.1.2. This testing shall be in addition to tensile testing as specified in 9.1.1. The lot size shall be as shown in 12.1.1. Failure shall occur in the body or threaded section with no failure, or indications of failure, such as cracks, at the junction of the head and shank.

## 13. Nuts

13.1 Bolts, studs, and stud bolts shall be furnished with nuts, when specified in the purchase order. Nuts shall conform to Specification A 194/A 194M.

## 14. Rejection and Rehearing

14.1 Unless otherwise specified in the basis of purchase, any rejection based on product analysis shall be reported to the manufacturer within 30 days from the receipt of samples by the purchaser.

14.2 Material that shows defects subsequent to its acceptance at the place of manufacture shall be rejected, and the manufacturer shall be notified.

14.3 *Product Analysis*—Samples that represent rejected material shall be preserved for two weeks from the date of the test report. In the case of dissatisfaction with the results of the test, the manufacturer may make claim for a rehearing within that time.

## 15. Certification

15.1 The producer of the raw material or finished fasteners shall furnish a certification to the purchaser or his representative showing the results of the chemical analysis, macroetch examination (Carbon and Alloy Steels Only), and mechanical tests, and state the method of heat treatment employed.

15.2 Certification shall also include at least the following:

15.2.1 A statement that the material or the fasteners, or both, were manufactured, sampled, tested, and inspected in accordance with the specification and any supplementary requirements or other requirements designated in the purchase order or contract and was found to meet those requirements.

15.2.2 The specification number, year date, and identification symbol.

## 16. Product Marking

16.1 The marking symbol and manufacturer's identification symbol shall be applied to one end of studs ¾ in. [10 mm] in diameter and larger and to the heads of bolts ¼ in. [6 mm] in diameter and larger. (If the available area is inadequate, the marking symbol may be placed on one end with the manufacturer's identification symbol placed on the other end.) The marking symbol shall be as shown in Table 4 and Table 5. Grade B7M, which has been 100 % evaluated in conformance with the specification, shall have a line under the marking symbol to distinguish it from B7M produced to previous specification revisions not requiring 100 % hardness testing.

16.2 For bolting materials, including threaded bars, furnished bundled and tagged or boxed, the tags and boxes shall carry the marking symbol for the material identification and the manufacturer's identification symbol or name.

16.3 For purposes of product marking, the manufacturer is considered the organization that certifies the fastener was manufactured, sampled, tested, and inspected in accordance with the specification and the results have been determined to meet the requirements of this specification.

16.4 *Bar Coding*—In addition to the requirements in 16.1, 16.2, and 16.3, bar coding is acceptable as a supplementary identification method. Bar coding should be consistent with AIAG Standard B-5 02.00. If used on small items, the bar code may be applied to the box or a substantially applied tag.

## 17. Keywords

17.1 hardness; heat treatment

**TABLE 4 Marking of Ferritic Steels**

Grade	Marking Symbol
B5	B5
B6	B6
B6X	B6X
B7	B7
B7M <sup>A</sup>	B7M
	<u>B7M</u>
B16	B16

<sup>A</sup> For explanations, see 9.2.2 and 16.1.



**A 193/A 193M – 04a****TABLE 5 Marking of Austenitic Steels**

Class	Grade	Marking Symbol
Class 1	B8	B8
	B8C	B8C
	B8M	B8M
	B8P	B8P
	B8T	B8T
	B8LN	B8F or B8LN
	B8MLN	B8G or B8MLN
Class 1A	B8A	B8A
	B8CA	B8B or B8CA
	B8MA	B8D or B8MA
	B8PA	B8H or B8PA
	B8TA	B8J or B8TA
	B8LNA	B8L or B8LNA
	B8MLNA	B8K or B8MLNA
	B8NA	B8V or B8MA
	B8MNA	B8W or B8MNA
	B8MLCuNA	B9K or B8MLCuNA
Class 1B	B8N	B8N
	B8MN	B8Y or B8MN
	B8MLCuN	B9J or B8MLCuN
Class 1C	B8R	B9A or B8R
	B8RA	B9B or B8RA
	B8S	B9D or B8S
	B8SA	B9F or B8SA
Class 1D	B8	B94
	B8M	B95
	B8P	B96
	B8LN	B97
	B8MLN	B98
	B8N	B99
	B8MN	B100
	B8R	B101
	B8S	B102
Class 2	B8	<u>B8</u>
	B8C	<u>B8C</u>
	B8P	<u>B8P</u>
	B8T	<u>B8T</u>
	B8N	<u>B8N</u>
	B8M	<u>B8M</u>
	B8MN	<u>B8Y</u>
	B8MLCuN	<u>B9J</u>
Class 2B	B8M2	<u>B9G or B8M2</u>
	B8	<u>B9</u>
Class 2C	B8M3	<u>B9H or B8M3</u>

**SUPPLEMENTARY REQUIREMENTS**

These requirements shall not apply unless specified in the order and in the Ordering Information, in which event the specified tests shall be made before shipment of the product.

**S1. High-Temperature Tests**

S1.1 Tests to determine high temperature properties shall be made in accordance with Test Methods E 21, E 139, and E 292, and Practices E 150 and E 151.

as agreed between the manufacturer and the purchaser. When testing temperatures are as low as those specified in Specification A 320/A 320M, bolting should be ordered to that specification in preference to this specification.

**S2. Charpy Impact Tests**

S2.1 Charpy impact tests based on the requirements of Specification A 320/A 320M, Sections 6 and 7, shall be made



### **S3. 100 % Hardness Testing of Grade B7M**

S3.1 Each Grade B7M bolt or stud shall be tested for hardness by indentation method and shall meet the requirements specified in Table 2.

### **S4. Hardness Testing of Grade B16**

S4.1 For bolts or studs 2½ in. [65 mm] or smaller, the hardness for Grade B16 shall be measured on or near the end of each bolt or stud using one of the methods prescribed in 9.2.1 for the Brinell or Rockwell C test. The hardness shall be in the range 253–319 HB or 25–34 HRC.

### **S5. Product Marking**

S5.1 Marking and manufacturer's identification symbols shall be applied to one end of studs and to the heads of bolts of all sizes. (If the available area is inadequate, the marking symbol may be marked on one end and the manufacturer's identification symbol marked on the other end.) For bolts smaller than ¼ in. [6 mm] in diameter and studs smaller than ¾ in. [10 mm] in diameter and for ¼ in. [6 mm] in diameter studs requiring more than a total of three symbols, the marking shall be a matter of agreement between the purchaser and the manufacturer.

### **S6. Stress Relieving**

S6.1 A stress-relieving operation shall follow straightening after heat treatment.

S6.2 The minimum stress-relieving temperature shall be 100°F [55°C] below the tempering temperature. Tests for mechanical properties shall be performed after stress relieving.

### **S7. Magnetic Particle Inspection**

S7.1 Bars shall be magnetic particle examined in accordance with Guide E 709. Bars with indications of cracks or seams are subject to rejection if the indications extend more than 3 % of the diameter into the bar.

### **S8. Stress-Relaxation Testing**

S8.1 Stress-Relaxation Testing, when required, shall be done in accordance with Test Methods E 328. The test shall be performed at 850°F [454°C] for a period of 100 h. The initial stress shall be 50 M psi [345 MPa]. The residual stress at 100 h shall be 17 M psi [117 MPa] minimum.

### **S9. Grain Size Requirements for Non H Grade Austenitic Steels Used Above 1000°F**

S9.1 For design metal temperatures above 1000°F [540°C], the material shall have a grain size of No. 7 or coarser as determined in accordance with Test Methods E 112. The grain size so determined shall be reported on the Certificate of Test.

### **S10. Hardness Testing of Class 2 Bolting Materials for ASME Applications**

S10.1 The maximum hardness shall be Rockwell C35 immediately under the thread roots. The hardness shall be taken on a flat area at least ⅛ in. [3 mm] across, prepared by removing threads, and no more material than necessary shall be removed to prepare the flat areas. Hardness determinations shall be made at the same frequency as tensile tests.

### **S11. Thread Forming**

S11.1 Threads shall be formed after heat treatment. Application of this supplemental requirement to grade B7M or the grades listed in 6.3.3 is prohibited.

## **APPENDIX**

### **(Nonmandatory Information)**

### **X1. STRAIN HARDENING OF AUSTENITIC STEELS**

X1.1 Strain hardening is the increase in strength and hardness that results from plastic deformation below the recrystallization temperature (cold work). This effect is produced in austenitic stainless steels by reducing oversized bars or wire to the desired final size by cold drawing or other process. The degree of strain hardening achievable in any alloy is limited by its strain hardening characteristics. In addition, the amount of strain hardening that can be produced is further limited by the variables of the process, such as the total amount of cross-section reduction, die angle, and bar size. In large diameter bars, for example, plastic deformation will occur principally in the outer regions of the bar so that the increased strength and hardness due to strain hardening is achieved predominantly near the surface of the bar. That is, the smaller

the bar, the greater the penetration of strain hardening.

X1.2 Thus, the mechanical properties of a given strain hardened fastener are dependent not just on the alloy, but also on the size of bar from which it is machined. The minimum bar size that can be used, however, is established by the configuration of the fastener so that the configuration can affect the strength of the fastener.

X1.3 For example, a stud of a particular alloy and size may be machined from a smaller diameter bar than a bolt of the same alloy and size because a larger diameter bar is required to accommodate the head of the bolt. The stud, therefore, is likely to be stronger than the same size bolt in a given alloy.





## A 193/A 193M – 04a

### SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A 193/A 193M – 04, that may impact the use of this specification. (Approved May 11, 2004).

- |  |  |
|--|--|
| (1) Revised 9.1.1 to permit acceptance of strain hardened fasteners base on full size testing. | (3) Changed “Grade” to “Marking” in Section 17 and Supplementary Requirement S5. |
| (2) Revised B6 carbon content in Table 1.  | (4) Updated Table 5.   |

Committee A01 has identified the location of selected changes to this specification since the last issue, A 193/A 193M – 03, that may impact the use of this specification. (Approved January 1, 2004).

- |   |                          |
|---|--------------------------|
| (1) Corrected Yield Strength for Class 2, B8M, B8MN, B8MLCuN $\frac{3}{4}$ (M20) and under in Tables 2 and 3. | (2) Deleted Appendix X2. |
|---|--------------------------|

Committee A01 has identified the location of selected changes to this specification since the last issue, A 193/A 193M – 01b, that may impact the use of this specification. (Approved May 10, 2003).

- |   |  |
|---|--|
| (1) Revised 4.2 to reference the general requirements specification for macroetch requirements. | (2) Revised 6.5 to permit surface conditioning prior to testing. |
|---|--|

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44.00



# CERTIFICATE OF COMPLIANCE / CERTIFICAT DE CONFORMITÉ

Order No. / No. Commande	CUSTOMER / CLIENT	Packing slip / No. d'expédition	DATE
Order No. / No. Commande	CUSTOMER / CLIENT	Packing slip / No. d'expédition	DATE
AC00003033	LES ACIERS OUELLETTE INC	L07735-01	10-02-17
MATERIAL ID# / No. MATÉRIEL	GRADE / NUANCE	HEAT TREATMENT / TRAITEMENT THERMIQUE	HEAT / COULÉE
2015-2090	AISI 4140	Q.T.S.R / TREMPÉ REVENU - RECUIT DE DÉTENTE (RONDS)	144893

SHAPE / FORME	SIZE / DIMENSION	SPECIFICATIONS
Round / Rond	0.875 in.	ASTM A193/193M-01, A434-90a-BC
PAYS D'ORIGINE:	U.S.A.	

## CHEMICAL COMPOSITION / ANALYSE CHIMIQUE

Carbon (C)		Silicon (Si)		Manganese (Mn)		Phosphorus (P)	
mini/maxi	0.380 0.430	0.150 0.350		0.750 1.000		0.035	
actuel (%):	0.410	0.280		0.890		0.007	
Sulfur (S)		Chromium (Cr)		Nickel (Ni)		Molybdenum (Mo)	
mini/maxi	0.040	0.800 1.100		0.000 0.250		0.150 0.250	
actuel (%):	0.018	0.828		0.073		0.158	
Copper (Cu)		Vanadium (V)		Aluminium (Al)		Tungsten (T)	
mini/maxi	0.350	----	----	----	----	----	----
actuel (%):	0.210	0.006		0.003		0.000	

## MECHANICAL PROPERTIES / PROPRIÉTÉS MÉCANIQUES

Yield strength / Élasticité	Tensile / résistance à la traction	Elongation / allongement (%)	Reduction of area / surface (%)	Hd/dure surface
133,900	146,100	20.0%	58.0%	301 BHN

No weld repairs performed during the manufacturing of this product. We hereby certify that the above results have been verified and conform to the above mentioned specifications. Material is Mercury free, without radioactivity.

Aucune réparation exécutée par soudure durant la fabrication de ce produit. Par la présente nous attestons que les résultats ci-haut mentionnés ont été vérifiés et sont conformes aux spécifications. Pas de contact au Mercure, sans radioactivité.

*Keith BALL - Branch Manager*



# MATERIAL RECEIPT INSPECTION FORM

MATERIAL: 4140HR0.375  
 DATE: Nov.20th, 2017

PO / BATCH NO.: PO038311/S009787

MATERIAL CERT REC'D: YES  
 QUANTITY RECEIVED: 12' 1 Bar  
 QUANTITY INSPECTED: 12' 1 Bar  
 QUANTITY REJECTED:

THICKNESS ORDERED: 0.375"  
 THICKNESS RECEIVED: 0.375"  
 SHEET SIZE ORDERED: N/A  
 SHEET SIZE RECEIVED: N/A

DESCRIPTION	NCR (Check Y/N)		COMMENTS
SURFACE DAMAGE	Y	N	
CORRECT FINISH	Y	N	
CORROSION	Y	N	
CORRECT GRAIN DIRECTION	Y	N	
CORRECT MATERIAL PER M-DRAWING	Y	N	YES SEE ATTACHED
CORRECT THICKNESS	Y	N	0.375"
PHOTO REQUIRED	Y	N	
CORRECT REF # TO LINK CERT	Y	N	HEAT 186784
CORRECT MATERIAL IDENTIFICATION	Y	N	4140HR0.375
CORRECT M# ON THE MATERIAL	Y	N	ASTM A304
DOES THIS MATERIAL REQUIRE ENGINEERING SIGN OFF	Y	N	
DOES THIS REQUIRE AN EXTRUSION REPORT	Y	N	

CUT SAMPLE PIECE OF MATERIAL AND PREFORM A HARDNESS CHECK. RECORD RESULTS BELOW					
	HRC	HRB	DUR A	DUR D	WEBSTER
TYPE OF MATERIAL					
SIZE OF TEST SAMPLE	N/A	N/A	N/A	N/A	N/A
HARDNESS / DUROMETER READING					

testers located in the Quality Office

QC 18 INSPECTION		ENGINEERING SIGNOFF (if required)
INSPECTED BY: <u>DAS 16</u> <small>3-89</small> DATE: <u>17/11/20</u>	SIGNED OFF BY: _____ DATE: _____	

Attach this inspection sheet with the corresponding material cert and remit to be scanned and received in





DESIGN #	DRAWN BY #	DART AEROSPACE LTD HAWKESBURY, ONTARIO, CANADA	
CHECKED #	APPROVED #	DRAWING NO. M4140H-R	REV. A SHEET 1 OF 1
DATE 05.02.21		TITLE 4140 ROUND BAR	SCALE 1:1
A	05.02.21	NEW ISSUE	

PURCHASE MATERIAL: AISI 4140H ROUND BAR

PER AISI 4140 OR ASTM A304-02 / -A-434-BC /

-A193-03- GRADE-B7 / -A29-03 / -A322-91 OR

UNS # - G41400

MINIMUM ULTIMATE TENSILE STRENGTH = 100 ksi

MINIMUM YIELD TENSILE STRENGTH = 66 ksi

PART NUMBER: M4140H-R | D.DDD | WHERE D.DDD = DIAMETER IN INCHES  
DIA.

EG.  $\frac{7}{8}$ " ROUND BAR = M4140H-R0.875

RELEASED  
05 03 25

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**ACIER OUELLETTE INC.**  
935, Boul. du Havre  
Sablery de Valleyfield (Québec) J6S 5L1  
Tél.: 450-377-4248 Mtl: 514-336-4248 Ext.: 800-667-4248  
Fax: 450-377-5696 Mtl: 514-336-4246 Ext.: 866-456-4242

## Order - Sales

Copy

CO00061367

Customer N° CL10001056

Date 2017/11/10

Delivery date 2017/11/14

Your order N° 38311

Processed by Josianne Bourdon

Salesman

Carrier OUELLETTE VALLEYFIELD

Credit Terme Net 30 Days

### Billed to

DART AEROSPACE LTD  
1270, ABERDEEN ST.  
HAWKESBURY, Ontario, K6A 1K7

### Shipped to

, Ontario,  
Att: CHANTAL LAVOIE Tél.: 613-632-5200  
Delivery Route 5

Page

1

Product Description	Weight	Qty	U/M	PCS NB			Internal Use Only			
				CMD	EXP	B/O	IN	I	S	C
1 ROUND 4140 HT SR 3/8 NS R4140-38H 9446  1 X 12' HEAT: 186784 AC11151-M5-13/11	4.51	12.00	PL_\$CLB	1.00						

### Conditions:

All sold and delivered materials remain the property of "Acier Ouellette Inc." until payment is made in full, complete and cashed. All lost materials are at the buyer's expense. The warranty offered by "Acier Ouellette Inc." is the same as offered and provided by the manufacturer and his warranty is transferred by "Acier Ouellette Inc." to the client. The buyer hereby accepts to respect the to owing conditions: Net 30 days from billing date and the buyer accepts to pay administration charges of 2% per month (24% per annum) on all past due amounts over 30 days. Any default in respect with this contract will lead to payment by acceleration and permits to the seller, at his choice to claim for the balance due or the repossession of the goods sold. All claims must be made within five (5) days with this document enclosed. Any merchandise that has been damaged, cut or modified cannot be returned. All goods returned must be with our authorization and are subject to a 25% restocking charge.

Prepared By : Verified By :

Delivered By : Time

Customer's Signature

Y M D

Total (\$CAD)

Deposit  
Balance

141.25  
0.00  
141.25



CO. 61367 PART

PO. 11151

Page 01 of 02

CUSTOMER ORDER NUMBER  
NUMÉRO DE COMMANDE DU CLIENTCertification Date  
11-APR-201742252-M  
PART NUMBER/NUMÉRO DE PIÈCEInvoice Number  
T365169

506029

Description: 4142 CF HEAT TREATED S/R OR STRESS FREE BAR  
3/8 RD X 12' R/L Line Total: 23 LB  
HEAT: 186784 ITEM: 506029

## Specifications:

ASTM A434 CL BC 12  
ASTM A304 11  
ASTM A29 15  
EN 10204 3.1 04  
ASTM E112 13

ASTM A193 GR B7 15  
ASTM A322 13  
ASTM A962 14  
ASTM A255 10  
ASTM E381 01

ASTM A108 13  
ASTM A331 95  
MIC2016 12  
ASTM E10 15  
ASTM E709 14

## CHEMICAL ANALYSIS

C	MN	SI	P	S	CR	NI	MO
0.42	0.94	0.26	0.012	0.021	1.02	0.10	0.23
CU	AL	CA					
0.16	0.021	0.0009					

RCPT: R186462

COUNTRY OF ORIGIN : SPAIN

## MECHANICAL PROPERTIES

DESCRIPTION	YLD STR KSI	ULT TEN KSI	%ELONG IN 02 IN	%RED IN AREA	HARDNESS BHN
	126.0	139.0	19.8	60.8	291

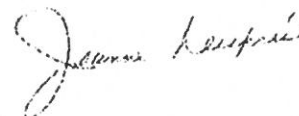
IDEAL DIAMETER : 6.426 IN GRAIN SIZE : 7

The above data were transcribed from the manufacturer's Certificate of Test after verification for completeness and specification requirements of the information on the certificate. All test results remain on file subject to examination. /Les informations ci-haut-mentionnées sont transcrites du certificat d'essais du manufacturier après vérification de l'état complet des spécifications inscrites sur le certificat. We hereby certify that the material covered by this report will meet the applicable requirements described herein, including any specification forming a part of the description. /Par les présentes, nous certifions que le matériel couvert par ce rapport rencontre les spécifications décrites ci-haut.

The willful recording of false, fictitious, or fraudulent statements in connection with test results may be punishable as a felony under federal statutes. /Les informations fausses, fictives ou frauduleuses en rapport avec le résultat des essais sont punissables en vertu des lois fédérales.

Material did not come in contact with mercury while in our possession. /Par les présentes, nous certifions que le matériel couvert par ce rapport rencontre les spécifications décrites ci-haut.

JOANNE DESPRES



MANAGER QUALITY ASSURANCE



CUSTOMER ORDER NUMBER  
NUMÉRO DE COMMANDE DU CLIENT

Certification Date  
11-APR-2017

42252-M  
PART NUMBER/NUMÉRO DE PIÈCE

Invoice Number  
T365169

506029

Description: 4142 CF HEAT TREATED S/R OR STRESS FREE BAR  
3/8 RD X 12' R/L  
HEAT: 186784  
CLEANLINESS  
ITEM: 506029  
Line Total: 23 LB

	A		B		C		D	
	THIN MAX	THICK MAX	THIN MAX	THICK MAX	THIN MAX	THICK MAX	THIN MAX	THICK MAX
E45	1.5	0.0	1.0	0.0	0.0	0.0	0.5	0.0

STRAND CAST VACUUM DEGASSED  
MATERIAL IS FREE FROM MERCURY CONTAMINATION  
NO WELD REPAIR PERFORMED ON MATERIAL EDDY CURRENT/MAGNETIC TEST PERFORMED  
THERMAL TREATMENT: OK  
QUENCHED 1562F 45 MINUTES  
OIL COOLED 95F START, 112F FINISH  
TEMPERED 1202F 150MINUTES, AIR COOLED  
MACRO: OK  
MICRO: OK

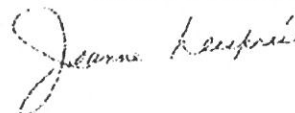
#### COMMENTS

melt & mfg in USA  
free from harmful radioactive contamination  
red. ratio 305.9:1

The above data were transcribed from the manufacturer's Certificate of Test after verification for completeness and specification requirements of the information on the certificate. All test results remain on file subject to examination. /Les informations ci-haut-mentionnées sont transcrites du certificat d'essais du manufacturier après vérification de l'état complet des spécifications inscrites sur le certificat. We hereby certify that the material covered by this report will meet the applicable requirements described herein, including any specification forming a part of the description. /Par les présentes, nous certifions que le matériel couvert par ce rapport rencontre les spécifications décrites ci-haut.  
The willful recording of false, fictitious, or fraudulent statements in connection with test results may be punishable as a felony under federal statutes. /Les informations fausses, fictives ou frauduleuses en rapport avec le résultat des essais sont punissables en vertu des lois fédérales.

Material did not come in contact with mercury while in our possession /Par les présentes, nous certifions que le matériel couvert par ce rapport rencontre les spécifications décrites ci-haut.

JOANNE DESPRES



MANAGER QUALITY ASSURANCE



# MATERIAL RECEIPT INSPECTION FORM

MATERIAL: 5052H32S.063  
 DATE: Nov.20th, 2017

PO / BATCH NO.: PO038311/S009786

MATERIAL CERT REC'D: YES  
 QUANTITY RECEIVED: 2 sheets / 64'  
 QUANTITY INSPECTED: 2 sheets / 64'  
 QUANTITY REJECTED:                     

THICKNESS ORDERED: 0.063"  
 THICKNESS RECEIVED: 0.062"  
 SHEET SIZE ORDERED: 4'x8'  
 SHEET SIZE RECEIVED: 4'x8'

DESCRIPTION	NCR (Check Y/N)		COMMENTS
SURFACE DAMAGE	Y	N	
CORRECT FINISH	Y	N	
CORROSION	Y	N	
CORRECT GRAIN DIRECTION	Y	N	
<b>CORRECT MATERIAL PER M-DRAWING</b>	Y	N	YES SEE ATTACHED
CORRECT THICKNESS	Y	N	0.062"
PHOTO REQUIRED	Y	N	
CORRECT REF # TO LINK CERT	Y	N	HEAT 016110624-4
CORRECT MATERIAL IDENTIFICATION	Y	N	5052H32s.063 S009786
CORRECT M# ON THE MATERIAL	Y	N	AMS-QQ-A-250/8B
DOES THIS MATERIAL REQUIRE ENGINEERING SIGN OFF	Y	N	
DOES THIS REQUIRE AN EXTRUSION REPORT	Y	N	

CUT SAMPLE PIECE OF MATERIAL AND PERFORM A HARDNESS CHECK. RECORD RESULTS BELOW					
	HRC	HRB	DUR A	DUR D	WEBSTER
TYPE OF MATERIAL					
SIZE OF TEST SAMPLE	N/A	N/A	N/A	N/A	N/A
HARDNESS / DUROMETER READING					

testers located in the Quality Office

5

QC 18 INSPECTION		ENGINEERING SIGNOFF (if required)	
INSPECTED BY: <u>DAS</u>		SIGNED OFF BY: <u>                    </u>	
DATE: <u>9-89 17/11/20</u>		DATE: <u>                    </u>	

Attach this inspection sheet with the corresponding material cert and remit to be scanned and received in



# SPECIFICATION CONTROL DRAWING

PURCHASE MATERIAL: 5052-H32 ALUMINUM SHEET

SPECIFICATION: QQ-A-250/8 OR AMS-QQ-A-250/8  
OR AMS 4016  
OR ASTM B209

PART NUMBER: M5052H32S | XXX  
THK

WHERE "XXX" = SHEET THICKNESS (IN INCHES)

EG. 0.063" THICK SHEET = M5052H32.063

PREFERRED SIZE: .XXX BY 4FT BY 8FT

RELEASED  
R 2009-10-30  
MP

DESIGN	REFORMAT DWG. ADD B208 SPEC (ZN D8-1), PAR 08-020A	CP	09.09.26
DRAWN	NEW ISSUE	DS	01.06.08
CHECKED		BY	DATE
MFG. APPR.			
APPROVED			
DE APPR.			
DATE	09.09.26		
DART AEROSPACE LTD HAWKESBURY, ONTARIO, CANADA			
DRAWING NO. M5052H32S			
TITLE 5052-H32 SHEET SPEC			
REV. B			
SHEET 1 OF 1			
SCALE NTS			
NOT TO BE USED FOR ANY PURPOSE OR ON ANY DRAWING WITHOUT THE WRITTEN PERMISSION OF DART AEROSPACE LTD.			







浙江永杰铝业有限公司  
**Zhejiang Yongjie Aluminum Co., Ltd.**  
 Jiangdong Industrial Area, Xiaoshan Economic and Technology Development Zone, Hangzhou, 311222, China

**MILL TEST**

To: EMPIRE RESOURCES, INC.  
 2115 LINWOOD AVENUE, FORT LEE, NEW JERSEY 07024, USA  
 TEL: 201.944.2200 X 1231 FAX: 201.944.2226  
 SHIPPING MARKS: N/M

浙江永杰铝业公司  
 ZHEJIANG YONGJIE ALUMINUM CO., LTD

Invoice No.: YJ170106-5  
 Date: JAN. 8, 2016

Packag e No.	P O No.	Heat Number	Alloy/ Temper	Specification	Actual Thick ness	CHEMICAL COMPOSITION, %														MECHANICAL PROPERTIES		
						N.W. (MT)	G.W. (MT)	Si	Fe	Cu	Mn	Mg	Ni	Zn	Ti	Cr	Al	T.S. (KSI)	Yield (KSI)	Elongat ion (%)		
14-8	R1533331	016110804-2	5052-H32	0.125""48""96"	0.125	2.076	2.128	0.080	0.220	0.010	0.010	2.430	--	0.008	0.013	0.170	97.06	32.6	25.5	10.0		
14-9	R1533331	016110804-3	5052-H32	0.125""48""96"	0.125	2.074	2.134	0.080	0.220	0.010	0.010	2.430	--	0.008	0.013	0.170	97.06	32.6	25.5	10.0		
14-10	R1533331	016110855-4	5052-H32	0.090""48""96"	0.080	1.792	1.852	0.070	0.230	0.010	0.010	2.340	--	0.004	0.015	0.180	97.14	31.6	25.2	12.0		
14-11	R1533331	016110835-3	5052-H32	0.090""48""96"	0.089	1.788	1.848	0.070	0.220	0.010	0.010	2.390	--	0.003	0.018	0.180	97.10	32.2	26.5	12.5		
15-1	R1533333	016110902-3	5052-H32	0.063""48""96"	0.063	2.077	2.130	0.080	0.230	0.010	0.010	2.440	--	--	0.017	0.170	97.04	33.8	27.1	11.0		
15-2	R1533333	016110872-4	5052-H32	0.063""48""96"	0.062	2.079	2.130	0.070	0.230	0.010	0.010	2.450	--	0.004	0.016	0.170	97.04	33.5	26.1	12.0		
15-3	R1533333	016110902-4	5052-H32	0.063""48""96"	0.063	2.078	2.130	0.080	0.230	0.010	0.010	2.440	--	--	0.017	0.170	97.04	33.8	27.1	11.0		
15-4	R1533333	016110875-5	5052-H32	0.063""48""96"	0.063	2.028	2.080	0.070	0.230	0.010	0.010	2.460	--	0.004	0.016	0.170	97.04	33.8	26.4	13.0		
15-5	R1533333	016110855-6	5052-H32	0.090""48""96"	0.090	1.846	1.908	0.070	0.230	0.010	0.010	2.340	--	0.004	0.015	0.180	97.14	31.6	25.2	12.0		
15-6	R1533333	016110894-1	5052-H32	0.125""60""120"	0.124	1.897	1.974	0.100	0.230	0.010	0.020	2.430	--	--	0.015	0.180	97.00	33.2	26.8	13.5		
15-7	R1533333	016110294-5	5052-H32	0.125""60""120"	0.124	1.821	1.898	0.080	0.220	0.010	0.010	2.450	--	0.008	0.014	0.180	97.03	33.1	27.9	10.5		
15-8	R1533333	016100161-2-1	5052-H32	0.090""48""120"	0.089	2.083	2.150	0.080	0.230	0.010	0.010	2.440	--	0.008	0.015	0.180	97.03	32.2	26.0	11.5		
15-9	R1533333	016100101-1-1	5052-H32	0.090""48""120"	0.089	1.788	1.856	0.080	0.230	0.010	0.010	2.440	--	0.008	0.015	0.180	97.03	32.2	26.0	11.5		
15-10	R1533333	016110621-5	5052-H32	0.090""48""120"	0.090	1.559	1.628	0.090	0.220	0.010	0.010	2.380	--	0.006	0.015	0.180	97.03	32.2	26.0	11.5		
15-11	R1533333	016110621-4	5052-H32	0.090""48""120"	0.090	1.908	2.040	0.090	0.220	0.010	0.010	2.380	--	0.009	0.012	0.170	97.10	31.9	25.4	10.5		
16-1	R1533333	016110682-3	5052-H32	0.125""48""96"	0.124	1.765	1.820	0.080	0.240	0.010	0.010	2.450	--	0.009	0.013	0.180	97.01	34.5	26.8	10.5		
16-2	R1533333	016110624-4	5052-H32	0.063""48""96"	0.062	2.068	2.120	0.090	0.220	0.010	0.010	2.380	--	0.009	0.012	0.170	97.10	33.1	26.0	13.0		
16-3	R1533333	016110624-2	5052-H32	0.063""48""96"	0.062	2.081	2.134	0.090	0.220	0.010	0.010	2.380	--	0.009	0.012	0.170	97.10	33.1	26.0	13.0		

MATERIAL CONFORMS FOR ALLOY 5052-H32 ALUMINUM ASSOCIATION STANDARDS, ASTM B209-10, AMS-QQ-A-250/BB AND AMS-4016L AND MATERIAL IN ALLOY 3003, H14/B052, H32CONFORMS TO ALUMINUM ASSOCIATION STANDARDS, ASTM B209-10, AMS-QQ-A-250/2 AND AMS 4008K, COUNTRY OF MELT AND MANUFACTURE IN CHINA.

MATERIAL CONFORMS TO ALLOY 5052-H32 ALUMINUM ASSOCIATION STANDARDS, ASTM B209-10, AMS-QQ-A-250/2B AND AMS-4016L AND MATERIAL IN ALLOY 3003, H14/B052, H32CONFORMS TO ALUMINUM ASSOCIATION STANDARDS, ASTM B209-10, AMS-QQ-A-250/2 AND AMS 4008K, COUNTRY OF MELT AND MANUFACTURE IN CHINA.

PC. 61563 DART

8/7/11/20



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CERTIFICATION DU MATÉRIEL

CLIENT:  
SALABERRY-DE-VALLEYFIELD

ACIER OUELLETTE INC DIV.DE  
935 BOUL DU HAVRE  
SALABERRY-DE-VALLEYFIELD, QUEBEC  
QC J6S 5L1

NUMÉRO DE COMMANDE: 14711181 000010  
COMMANDE DU CLIENT: AC11149  
NUMÉRO DE PIÈCES:  
NUMÉRO DE LIVRAISON: 803385329 000010  
NUMÉRO D'ARTICLE: 160002056  
DESCRIPTION INVENTAIRE: SHT 5052 H32 .063 X 48 X 96

DESCRIPTION ARTICLE FINIS: ALUM FL 5052 H32 PI  
0.063po X 48po X 96po

NUMERO (S) DE COULÉE BRAME / BOBINE / TIN (le cas échéant)  
016110624-4 016110624-4


**CERTIFICATION**

Un sondage de nos sources matérielles a indiqué que ni le mercure ni des substances radioactives ne sont introduits dans leurs produits ni ne sont utilisés dans aucun de leurs procédés. Alors que nous ne faisons aucun test indépendant pour le mercure ou la radiation, il n'y a rien dans le système de Ryerson qui pourrait entraîner la contamination de l'un ou l'autre type.

Ce document certifie que le matériel décrit ci-dessus a été expédié conformément à votre commande. Le producteur du matériel a certifié à Ryerson qu'il a été produit conformément aux spécifications suivantes:

ASTM B209 AMS 4016

11/13/2017

  
Thomas Endres  
Vice-président - Approvisionnement